Abstract No. lebo120

The Role of Vanadate in the Passivation of Zinc

N. Le Bozec, D. Thierry (Swedish Corrosion Institute), H.S. Isaacs (BNL)

Beamline(s):X26A

Introduction: Chromate is widely used as anti-corrosive pigment for coil-coated materials in the building industry. However, chromate is toxic and there is a need to find environmental friendly alternatives. Vanadates are potential alternatives. However, a better understanding in the mechanisms of passivation of vanadates on metals is required. XANES provides a unique technique for in-situ studies of the mechanisms of passivation of vanadates at undermining coated metal substrates.

Methods and materials: Magnesium vanadate and sodium vanadate compounds were investigated. The pigments were deposited on zinc. The valency of vanadate was then studied as a function of exposure to humid air as well as a function of pH in the depositing solution.

Results: Figure 1 shows the rate of reduction of V(V) to V(IV) as a function of the time of exposure in humid air. The rate of reduction of vanadate was much more rapid than that measured for Cr(VI) to Cr(III). This clearly indicates that the rate of corrosion of zinc was higher in the case of magnesium vanadate compared to strontium chromate [1]. This is in good agreement with scanning Kelvin probe and FTIR measurements showing that magnesium vanadate was a less efficient corrosion inhibitor than chromate for zinc under present exposure conditions [2]. However, as clearly indicated in Figure 1 an addition of magnesium phosphate to magnesium vanadate led to an important decrease in the rate of reduction of vanadate. The present results are in the same range to that observed for chromate under the same experimental conditions. The addition of phosphate led to an increase in the pH and consequently to a higher stability of the vanadate surface film. These results are encouraging with respect to find a replacement for chromate. The next step will be to introduce vanadate and phosphate as co-piments.

References:

[1]. N. Le Bozec, A. Nazarov, D. Thierry and H.S. Isaacs, "The rôle of chromate in the mechanisms of passivation and repassivation of undermining coatings on hot-dip galvanized steel surfaces", 200th meeting of the Electrochemical Society, San Francisco CA, September 2-7 2001.

[2]. N. Le Bozec, D. Thierry and H.S. Isaacs, manuscript in preparation for submission to Journal of Electrochemical Society.

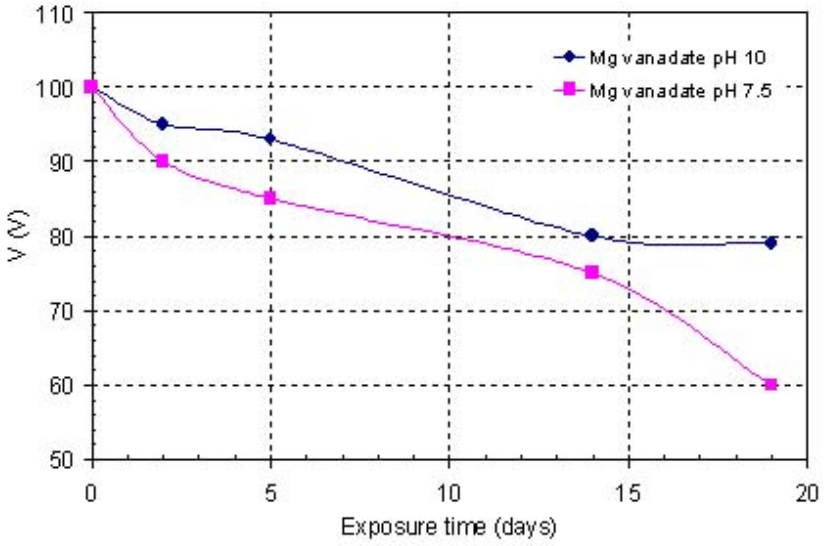

Figure 1: Dissolution of vanadate on zinc as a function of exposure to humid air for two pH in the depositing solution.